ASPECTS OF THE SILURIAN RUGOSE CORAL FAUNA OF THE YASS REGION, NEW SOUTH WALES

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(Plates XVIII–XXI)

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Synopsis

The biostratigraphic distribution of rugose corals in the Yass region is tabulated. The rugosans *Palaeocyathus australis* Foerste, *Entelophyllum yassense yassense* (Etheridge), *Entelophyllum yassense patulum* (Foerste) and *Zelolasma*? *praecox* (Hill) are revised. *Rhizophyllum brachiatum* sp. nov., a colonial form from the Barrandella Shale, is described.

Introduction

The rugose corals of the Yass area in southern New South Wales have been for many years the best known of any Silurian rugosans in Australia, primarily through the work of Hill (1940). Recent study of the stratigraphy and conodont faunas of the sequence in the area and a more precise determination of its age (Link, 1970 ; Link and Druce, 1972) has prompted reappraisal of the biostratigraphy of the Rugosa of this classic succession. In addition several forms inadequately known previously are revised herein and a new species described.

Text-fig. 1 illustrates the stratigraphic range of species here recognised, with proposed generic assignments. It is based on the work of Hill (1940), Brown (1941), Link and Druce (1972) and collections of the present writer.

Systematic Palaeontology

Specimen numbers in the University of Sydney Palaeontological Collections have the prefix SUP. Fossil numbers in the Australian Museum, Sydney, bear the prefix AM.F. Fossil numbers of the Geological and Mining Museum, Sydney, have the prefix MMF.

Family DENSIPHYLLIDAE Dybowski, 1873

Genus PALAEOCYATHUS Foerste, 1888

1852	*Streptelasma* (*part.*) ; Hall, p. 3 (*non* Hall, 1847)
1869	*Petraia* ; Safford, p. 320 (*non* Münster, 1839)
1874	*Streptelasma* ; Hall, p. 114
?1879	*Streptelasma* (*part.*) ; Hall, p. 106
1887	*Streptelasma* ; Hall and Simpson, p. 1
1888	*Cyathophyllum* (*part.*) ; Foerste, p. 128 (*non* Goldfuss, 1826)
?1890	*Cyathophyllum* ; Foerste, p. 341.
?1890	*Streptelasma* (*part.*) ; Foerste, p. 345
1900	*Enterolasma* Simpson, p. 203
1901	*Streptelasma* (*part.*) ; Lambe, p. 107
1909	*Enterolasma* ; Brown, p. 58
1909	*Enterolasma* ; Brown, p. 65
1940	*Streptelasma* ; Hill, p. 409
1949	*Enterolasma* ; Amsden, p. 103

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HORIZON / SPECIES	Cliftonwood Limestone	Euralie Limestone Mbr	Bowspring Limestone Mbr	Barrandella Shale Mbr	Hume Limestone Mbr	Yarwood Siltstone Mbr	Rainbow Hill Marl Mbr
Palaeocyathus australis							X
Phaulactis shearsbyi	X	X	X	X	X		
Entelophyllum yassense yassense			X	X	X		
E. yassense patulum				X	X	X	
Zenophila? walli					X		
Zelolasma? praecox			X	X			
Australophyllum spongophylloides			X	X	X		
A.? shearsbii			X	X			
Yassia enormis			X				
Mucophyllum liliiforme			X	X			
M. crateroides				X	X		
Pycnostylus congregationis				X			
P. dendroides			X	X			
Tryplasma lonsdalei		X	X	X	X		
T. delicatulum				X			
T. derrengullenense				X			
Cystiphyllum cf. siluriense bohemicum			X				
C. sp.				X			
Halmophyllum multiseptatum	X						
H. calligatum			X				
Rhizophyllum interpunctatum	X			X			
R. robustum	X						
R. yassense				X			
R. brachiatum				X			

Text-fig. 1. Stratigraphic distribution of rugose coral species in the Yass region.

1952 *Orthopaterophyllum* Nikolaeva *in* Bulvanker, p. 7
1960 *Orthopaterophyllum* ; Nikolaeva *in* Bulvanker *et al.*, p. 221
1965 *Enterolasma* ; Sutherland, p. 22
1965 *Enterolasma* ; Kullmann, p. 143
1971 *Enterolasma* ; Dubatolov and Spasskiy, p. 81

Type species. *Cyathophyllum* (*Palaeocyathus*) *australe* Foerste, 1888. Rainbow Hill Marl Member, Yass region. Late Ludlow.

Diagnosis (based on diagnosis of "*Enterolasma*" by Sutherland, 1965). Corallum solitary, small, trochoid or ceratoid. Major septa long, with irregular carinae or tubercles on their sides. Axial edges of major septa lobed, forming irregular, open-meshed axial structure having appearance of twisted rods. Tabulae complete or incomplete, dissepiments lacking.

Discussion. Foerste (1888, p. 129) suggested *Palaeocyathus* as a subgeneric name for his species *Cyathophyllum australe* (1888, p. 128) from the Yass area. It was subsequently considered a synonym of *Streptelasma* Hall by Hill (1940). Study of further, more complete material of *Palaeocyathus* (see below) has shown its distinction from *Streptelasma* on the basis of having a loose axial structure and weak development of carinae or tubercles on the septa. These features ally the form to *Enterolasma* Simpson, 1900. According to Simpson (1900, pp. 204–5) *Enterolasma* is characterised by a pseudocolumella of twisted septal lobes and the presence of numerous carinae or tubercles on the sides of the septa. The Yass species has only sparsely developed carinae or tubercles, but according to Brown (1909, p. 59) *Streptelasma caliculum* Hall, 1852, included in *Enterolasma* by Simpson (1900), possesses a weakly developed *Enterolasma*-type axial structure, but lacks the tubercles on the septa. Hence the major diagnostic feature of *Enterolasma* would appear to be the peculiar axial structure and as this feature is clearly developed in *Palaeocyathus* (herein, Pl. XVIII, figs 3, 7), *Enterolasma* is here regarded as junior synonym of *Palaeocyathus*.

The writer has followed Weyer (1974) in placing "*Enterolasma*" (=*Palaeocyathus*) in the family Densiphyllidae Dybowski, characterised according to Weyer by forms bearing the peculiar axial structure of twisted septal lobes and lamellae ("axial synapticulae" of Weyer) found in *Palaeocyathus*. The genus *Rhegmaphyllum* Wedekind, 1927, as revised by Weyer (1974) and included also in the Densiphyllidae, is closely similar to *Palaeocyathus*, differing mainly in showing a markedly shortened cardinal septum and fossula, together with a more weakly developed axial structure.

Of the North American forms listed as belonging to "*Enterolasma*" by Bassler (1950), only three have been studied and illustrated in thin section. "*E.*" *strictum* (Hall, 1874), the type species of "*Enterolasma*" from the early Devonian (Helderbergian) New Scotland Limestone of New York (Oliver, 1960), has been illustrated by Hall and Simpson (1887, Pl. 1, figs. 1–10), Simpson (1900, Figs 11, 12) and Brown (1909, p. 66, Figs 1, 2). "*E.*" *waynense* (Safford, 1869) from the Brownsport Formation (Ludlow) of Tennessee has been illustrated by Sutherland (1965, Pl. 30, figs 1–3 ; Pl. 31, figs 4, 5). "*E.*" *caliculum* (Hall, 1852) from the "Niagara Formation" of New York and Ontario has sections illustrated by Lambe (1901, Pl. VII, figs 4a, b) and Brown (1909, Figs 11–26). This species has been recorded from many localities in the Silurian of North America (Bassler, 1950). The other species of "*Enterolasma*" listed by Bassler (1950) include "*E.*" *radicans* (Hall, 1879, p. 106, Pl. 5, figs 1–4) from the Waldron Shale (Upper Wenlock) of Indiana and "*E.*" *facetum* (Foerste, 1890, p. 341, Pl. IX, fig. 8) and "*E.*" *geometricum* (Foerste, 1890, p. 345, Pl. IX, figs 7, 12, 13), both from the Brassfield Limestone (?Middle-Upper Llandovery) of Ohio. These three forms are recorded as having "crenulated septa", but their inclusion in *Palaeocyathus* cannot be confirmed without thin-section study.

The synonymy of the genus *Orthopaterophyllum* Nikolaeva *in* Bulvanker, 1952 with "*Enterolasma*" has been suggested by Ivanovskiy (1965*b*), Kullmann (1965), Dubatolov and Spasskiy (1971) and Weyer (1974). In view of their comparable septal and axial structures, these genera are regarded as synonymous here also and consequently *Orthopaterophyllum* becomes a junior synonym of *Palaeocyathus*. Several forms attributed to "*Orthopaterophyllum*" ("*O.*" *kasachstanicum* Nikolaeva, "*O.*" *cornuformis* Nikolaeva and "*O.*" *tschernyshewi* Spasskiy) require description of their tabular structure, but their inclusion in *Palaeocyathus* on the basis of septal structure would seem beyond doubt.

Protosyringaxon primitivum Ivanovskiy, 1963 from the Upper Llandovery of the River Moyero, Siberian Platform, was listed as a representative of "*Enterolasma*" by Ivanovskiy (1970). However, it has been illustrated only in external view (Ivanovskiy, 1963*b*, Pl. VI, fig. 3) and its affinities cannot be certain.

The genus *Paterophyllum* Počta, 1902 has been included by some authors as a synonym of "*Orthopaterophyllum*" or "*Enterolasma*" (e.g. Nikolaeva *in* Bulvanker *et al.*, 1960; Kullmann, 1965; Dubatolov and Spasskiy, 1971). However, the original material of Počta (1902) from the early Devonian of Bohemia requires detailed study before this synonymy can be confirmed.

It would appear that many of the species of *Palaeocyathus* can be separated into two distinct morphological groups. First there are forms having markedly thickened septa in the ephebic stage, the septa having pronounced tubercles or carinae on their sides. Included in this group are *P. strictus* (Hall, 1874) and *P. waynense* (Safford, 1869). Also showing this morphology are *P. tschernyschewi* (Spasskiy *in* Bulvanker *et al.*, 1960) and possibly *P. cornuformis* (Nikolaeva *in* Bulvanker *et al.*, 1960). A second group of species tends to show slender septa in the ephebic stage with tubercles of varying dimensions, although generally small, on the septa. Included among these forms are *P. australis* Foerste, 1888, *P. caliculus* (Hall, 1852), *P. conicus* (Nikolaeva *in* Bulvanker, 1952), *P. ibericus* (Kullmann, 1965) and possibly *P. kasachstanicus* (Nikolaeva *in* Bulvanker *et al.*, 1960). When all material referable to *Palaeocyathus* is adequately studied, and if this separation of species groups is found to be widely applicable, then it may be advisable to regard the groups as subgenera of *Palaeocyathus*.

Range. Llandovery of Ontario, Newfoundland, Indiana, ?Ohio; Late Llandovery-early Wenlock of New York, Ontario; Wenlock of Podolia, New York, Ontario, Ohio, Wisconsin, ?Indiana, ?Maine; Ludlow of N.S.W., New York, Ontario, Quebec, Missouri, Tennessee, Indiana, Oklahoma; ?Pridoli of New York; Late Silurian or early Devonian of Kazakhstan; Lower Devonian of Northern Spain, Kazakhstan, north-eastern America; ?Eifelian of south-west Siberia.

Palaeocyathus australis Foerste, 1888

Pl. XVIII, figs 1–7; Text-fig. 2

1888 *Cyathophyllum australe* Foerste, p. 128, Pl. XIII, figs 12–14.
1940 *Streptelasma australe* (Foerste); Hill, 1940, p. 410.

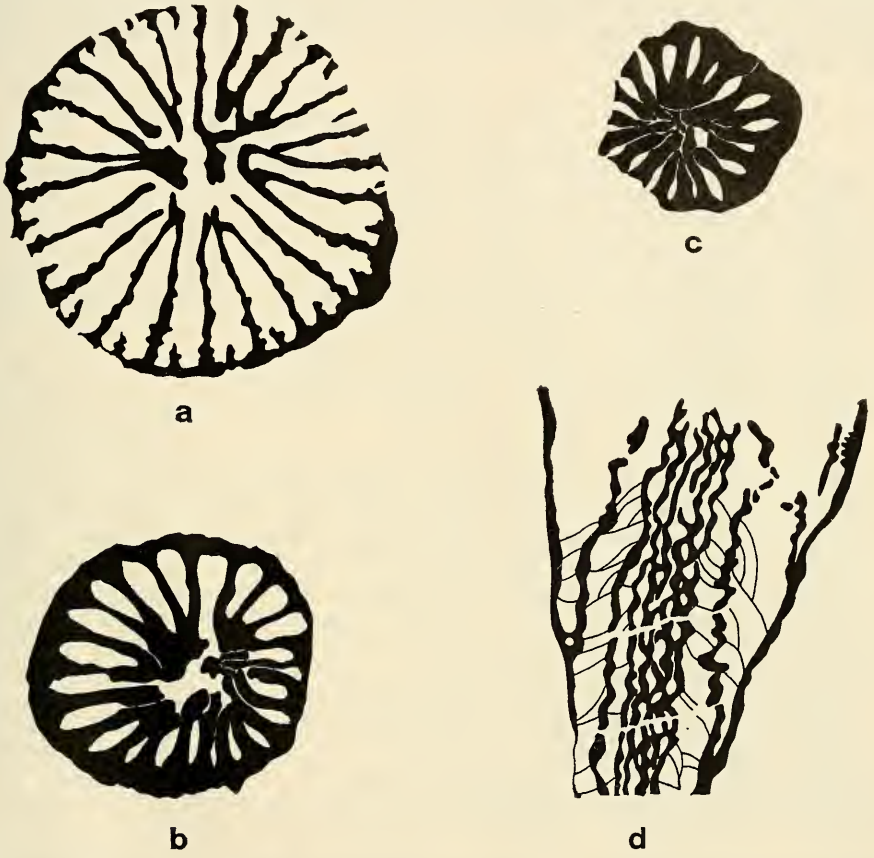
Lectotype. (chosen Hill, 1940) R 26519, British Museum (Nat. Hist.). "Hardened grey-brown shales east of Bowning Hill" (Hill, 1940, p. 410).

Present material. SUP 69227–69229, 74224–74227, Rainbow Hill Marl Member, Derringullen Creek; SUP 74221–74223, 74235–74241, Rainbow Hill Marl Member, near Black Range Road, "Belle Vale", Yass region. Late Ludlow.

Diagnosis. *Palaeocyathus* with septa dilated in neanic stage, slender in ephebic stage, with weak lateral "tubercles" or carinae. Axial structure clearly developed; peripheral stereozone weak in ephebic stage. Tabulae incomplete, strongly arched.

Description. Corallum solitary, trochoid to ceratoid, with extremely deep calice. Corallite diameter ranges up to 35 mm in largest specimen observed, with average diameter 8–10 mm at base of calice.

In neanic stage, septa are moderately dilated, particularly at periphery and axis (Pl. XVIII, figs 1, 2 ; Text-fig. 2c). Minor septa are not developed in this stage. In ephebic stage, septa are generally slender showing lateral extensions to a varying degree (Pl. XVIII, fig. 6), but it is not clear in available material



Text-fig. 2a–d. *Palaeocyathus australis* Foerste. a. SUP 69228, transverse section, ephebic stage, ×6. b. SUP 69227, transverse section, late neanic stage, ×6. c. SUP 74236a, transverse section, neanic stage, ×6. d. SUP 74239, longitudinal section, ×4.

if continuous carinae are developed. Their axial ends are frequently dilated and in contact, but peripheral stereozone is very narrow. Major septa range in number commonly from 23 to 26 in late ephebic stage (base of calice). Major septa slightly withdrawn from axis at base of calice, with minor septa, if developed, extending only up to 0·2 of length of major septa. Axial structure clearly apparent in longitudinal section, comprising loosely entwined septal lobes. Tabulae are incomplete, forming strongly arched floors, with average spacing 0·5–0·7 mm.

Remarks. The slender septa of *P. australis* in the ephebic stage ally it to the second group of *Palaeocyathus* discussed above.

P. caliculus (Hall, 1852) would appear to be quite similar to *P. australis*, especially in the ephebic stage (see Lambe, 1901, Pl. VII, fig. 4 ; Brown, 1909, Figs 11–26). *P. caliculus* differs in having generally weaker dilation of septa in the neanic stage and a rather wider stereozone in the ephebic stage. *P. conicus* (Nikolaeva *in* Bulvanker, 1952) from the Kitaygo Horizon (Wenlock) of Podolia shows similarities to *P. australis* in septal number, thin, weakly tuberculate septa, narrow peripheral stereozone and arched tabulae. However, the former may be distinguished by its rather more open, irregular axial structure in longitudinal section (Bulvanker, 1952, Pl. V, fig. 2 ; Pl. VI, fig. 6a), possibly more weakly dilated septa in the neanic stage (Bulvanker, 1952, Pl. VI, fig. 6v) and apparently more widely spaced tabulae.

Family ARACHNOPHYLLIDAE Dybowski, 1873

Genus ENTELOPHYLLUM Wedekind, 1927

1927 *Entelophyllum* Wedekind, p. 22
1927 *Xylodes* Lang and Smith, p. 461
?1930 *Petrozium* Smith, p. 307
1933 *Xylodes* (? *part.*) ; Smith, p. 513
1939 *Cyathophyllum* ; Shrock and Twenhofel, p. 250 (*non* Goldfuss, 1826)
1939 *Xylodes* (*part.*) ; Weissermel, p. 47
1940 *Entelophyllum* ; Hill, p. 411 (*cum syn.*)
1949 *Cyathophyllum* (*part.*) ; Amsden, p. 108
1951 *Entelophyllum* (*part.*) ; Schouppé, p. 244
1952 *Entelophyllum* ; Sytova, p. 137
1958 *Petrozium* ; Kaljo, p. 114
1959 *Entelophyllum* ; Ivanovskiy, p. 137
?1963*a* *Entelophyllum* ; Ivanovskiy, p. 85
1963*b* *Entelophyllum* (*part.*) ; Ivanovskiy, p. 83 (*cum. syn.*)
1965 *Entelophyllum* ; Sutherland, p. 26
1965 *Petrozium* ; Zheltonogova, p. 40
1971*a* *Entelophyllum* (? *part.*) ; Lavrusevich, p. 71
?1972 *Petrozium* ; Merriam, p. 37
?1973*a* *Petrozium* ; Merriam, p. 47
1973*a* *Entelophyllum* (? *part.*) ; Merriam, p. 48
1973*b* *Entelophyllum* (? *part.*) ; Merriam, p. 38 (*cum syn.*)
non 1952 *Xylodes* ; Bulvanker, p. 31
non 1962 *Entelophyllum* ; Flügel, p. 290
non 1965 *Entelophyllum* ; Zheltonogova, p. 41
non 1971 *Entelophyllum* ; Tcherepnina, p. 90

Type species. *Madreporites articulatus* Wahlenberg, 1821. " Upper Silurian ", Gotland

Diagnosis. Corallum ?solitary and colonial. Septa thin, often weakly carinate, major septa generally extending nearly to axis. Dissepiments mainly small, globose ; tabulae typically arched.

Discussion. Several Silurian genera show close similarities to *Entelophyllum*. *Stereoxylodes* Wang, 1944 and its possible synonym *Carinophyllum* Strelnikov, 1964 are both strongly carinate forms and their affinities with *Entelophyllum* have been discussed by McLean (1975). The position of the lonsdaleoid form *Strombodes* Schweigger, 1819 and its likely synonym *Evenkiella* Soshkina, 1955, has also been reviewed by McLean (1975). The genus *Micula* Sytova, 1952, was considered by Sutherland (1965) to differ from *Entelophyllum* only in its solitary growth form and thickening of the septa at the periphery. It may well be a synonym of *Entelophyllum*.

The systematic position of the genus *Petrozium* Smith, 1930 is not clear. According to the original description of Smith (1930, p. 307), the genus differs from *Entelophyllum* in having the axial ends of some of the major septa reinforced with sclerenchymal tissue so as to form a thin axial structure. Whether such a distinction, which is developed to varying degrees, is of generic importance is doubtful, Ivanovskiy (1965*a*, *b*), for example, regarding *Petrozium* as simply a synonym of *Entelophyllum*. Some species of *Petrozium* described by other authors (Kaljo, 1958 ; Zheltonogova, 1965) apparently lack the axial structure and are regarded as representatives of *Entelophyllum* (see Kaljo, 1970 and Hill, 1967). Two species described by Merriam (1972, 1973*a*) from North America have incipient development of an axial structure. *Petrozium* is here tentatively regarded as a synonym of *Entelophyllum*.

Forms of *Entelophyllum* like *E. rugosum* (Smith, 1933), *E. angulare* (Amsden, 1949), *E. medius* Ivanovskiy, 1963*a*, *E. nikolaievae* Lavrusevich, 1971*a* and *E. engelmanni* Merriam, 1973*a*, with a rather narrow dissepimentarium and uniseriate tabularium of flat or sagging tabulae, would appear to be significantly different to the type species of *Entelophyllum*, *E. articulatum* (Wahlenberg, 1821). This species is characterised by a wide dissepimentarium and biseriate or triseriate tabularium comprising generally strongly arched floors. The atypical species of *Entelophyllum* show closer similarities to the genus *Strephophyllum* Lavrusevich, 1971*a* (type species *S. princeps* Lavrusevich, 1971*a*, Horizon K—Lower Wenlock—Tadzhikistan), which differs from *Entelophyllum* in having generally sagging tabulae in a uniseriate tabularium. They could perhaps be considered congeneric with *Strephophyllum* or at least as intermediate between *Entelophyllum* and *Strephophyllum*.

The Devonian cyathophyllid *Cyathophyllum* (*Radiophyllum*) Hill, 1942 shows very close similarities to *Entelophyllum*, as noted by Hill (1942) and Jell and Hill (1969), emphasing a close affinity between the Cyathophyllidae and Silurian Arachnophyllidae. Judging by the illustrations of the type species, *C.* (*R.*) *arborescens* (Hill and Jones, 1940) from the Garra Formation (late Lochkovian to Pragian, A. E. H. Pedder, pers. comm. 1975) of N.S.W., given by Strusz and Jell (1970), it may be distinguished in having weak peripheral dilation of septa (although this feature is very variable) and a rather more irregular arrangement of the tabulae, although the basic entelophyllid style is recognisable. *Amaraphyllum* Pedder, 1970 (type species *A. amoenum* Pedder, 1970, Timor Limestone—Givetian—N.S.W.) appears very closely comparable to *Entelophyllum*, as mentioned by Pedder (*in* Pedder, Jackson and Ellenor, 1970, pp. 252–3). It shows greater similarity to *C.* (*Radiophyllum*) however, particularly to *C.* (*R.*) *arborescens*, in the slight peripheral septal dilation and more irregular spacing of tabulae, and is probably a representative of that subgenus. "*A.*" *amoenum* would not appear to belong to *Disphyllum*, contrary to the assertion of Rozkowska and Fedorowski (1972). *Entelophyllum devonicum* Tcherepnina, 1971 from the early Devonian Remnev Beds of the Altai would appear also to show closer affinities with *C.* (*Radiophyllum*) than with *Entelophyllum*.

Range. Upper Llandovery of Sweden, Siberian Platform, Tadzhikistan ; Wenlock of England, Gotland, Czechoslovakia, Urals, Siberian Platform, Tadzhikistan, Kazakhstan, north-east USSR, ?Indiana-Kentucky ; Ludlow of Norway, Gotland, Estonia, Urals, Podolia, Turkey, ?Tennessee, ?Oklahoma, ?Indiana-Kentucky ; Upper Silurian (undifferentiated) of Maine, Nevada.

Petrozium is recorded in the Middle Llandovery of Estonia ; Upper Llandovery of England ; Lower Wenlock of California ; Upper Wenlock of south-west Siberia and Upper Wenlock-Ludlow of California.

Entelophyllum yassense yassense (Etheridge, 1892)

Pl. XVIII figs 8–10 ; Pl. XIX fig. 1 ; Text-fig. 3

1892 *Heliophyllum yassense* Etheridge, p. 170, Pl. XI, fig. 8, Pl. XII, figs 1–3

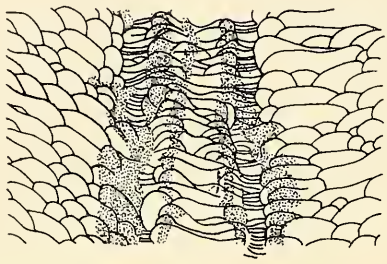
1936 *Xylodes yassense* (Etheridge) ; Jones, p. 56, Pl. VII, figs 3, 4 (*non* fig. 5)
1940 *Entelophyllum yassense* (Etheridge) ; Hill, p. 412, Pl. XIII, figs 11, 12

Type material. Missing (see Jones, 1936, p. 56).

Additional material. SUP 74253–74257. Barrandella Shale, Limestone Creek, " Silverdale "-" Allview " area, Yass region. Middle Ludlow.

Diagnosis. Corallum fasciculate. Septa very slender, weakly carinate, wavy. Minor septa up to 0·5 of length of major septa. Tabularium narrow, divided into axial arched series and periaxial concave series with tabulae very closely spaced.

Description. See Hill (1940, p. 412).



Text-fig. 3. *Entelophyllum yassense yassense* (Etheridge). SUP 74253c, longitudinal section, ×4.

Remarks. E. yassense yassense shows the tabular structure of the *E. articulatum* group of species i.e. a peripheral, distally concave series and an axial, arched series. This feature distinguishes it from the group of " *E.* " *rugosum* with mainly horizontal tabulae, mentioned above. The wide dissepimentarium and very closely spaced tabulae of the periaxial series serve to distinguish this form from other described species.

Entelophyllum yassense patulum (Foerste, 1888)
Pl. XIX, figs 2–6 ; Pl. XX, figs 1–3

1888 *Cyathophyllum patula* Foerste, p. 129, Pl. XIII, figs 9–11.
1940 *Entelophyllum yassense* var. *patulum* (Foerste) ; Hill, p. 413, Pl. XIII, figs 13*a*, *b*.

Type material. Missing (possibly in British Museum—Hill, 1940, p. 413). Yarwood Siltstone Member, Bowning (=" Lower trilobite bed, Bowning " of Hill, 1940, p. 413).

Additional material. SUP 69222–69226, 74248–74252. Barrandella Shale, Limestone Creek. " Silverdale "-"Allview " area, Yass region. Middle Ludlow.

Diagnosis. E. yassense with patellate corallum, either solitary or with calicinal offsets. Septa very numerous, thin, major septa extending to axis.

Description. Corallum is generally solitary, but at least three calical offsets have been observed in larger specimens (Pl. XIX, figs 3, 4). Parent corallum is patellate, expanding very rapidly after initiation of growth. Corallum height reaches at least 25 mm, with diameter up to 75 mm. Coralla are frequently asymmetrical. Septa are very thin, wavy, with very fine zigzag carinae. Major septa extend 0·5–0·6 of corallite radius. Septa range in number up to 170 in larger specimens. Formation of septa of offsets from major septa of parent corallite is illustrated in Pl. XIX, fig. 4 (note distortion of septa immediately prior to increase, Pl. XIX, fig. 6).

Tabulae and dissepiments are similar in structure to those of *E. yassense yassense.*

Remarks. This form, regarded here as a subspecies of *E. yassense*, is illustrated in thin-section for the first time and may be distinguished from *E. yassense yassense* by its patellate growth form and very numerous septa. It should be noted that *E. yassense yassense* occurs together with *E. yassense patulum* and that early growth stages of the nominate subspecies are closely similar to small *E. yassense patulum*, the latter tending to expand rather more rapidly.

Family DISPHYLLIDAE Hill, 1939

Genus ZELOLASMA Pedder, 1964

?1937 *Acervularia* (*part.*) ; Soshkina, p. 62 (*non* Schweigger, 1820)
?1940 *Disphyllum* ; Hill, p. 398 (*non* de Fromentel, 1861)
1964 *Zelolasma* Pedder, p. 364
1965 *Zelolasma* ; Strusz, p. 534
1970 *Zelolasma* ; Pedder, Jackson and Philip, p. 232 (*cum syn.*)
1971c *Zelolasma* ; Lavrusevich, p. 85

Type species. *Diphyphyllum gemmiformis* Etheridge, 1902. Cavan Limestone, Taemas Bridge, Murrumbidgee River, N.S.W. Lower Devonian (Late Pragian, A. E. H. Pedder, pers. comm. 1975).

Diagnosis. Corallum phaceloid to subcerioid. Septa generally subequal in length, thin, often wavy or weakly carinate and may show slight axial dilation. Dissepimentarium narrow, with globose dissepiments in several rows. Tabulae commonly complete, approximately flat and widely spaced.

Discussion. Oliver (1974) has distinguished the family Craspedophyllidae Dybowski (particularly subfamily Craspedophyllinae Oliver) from the Disphyllidae Hill on the basis of members of the former family having attenuate septa and well developed carinae, while those of the latter have septa thickened peripherally and lacking marked carinae. Under this interpretation, the genus *Zelolasma* Pedder, having attenuate septa peripherally but lacking carinae, would be intermediate in structure between representatives of the two families. It is tentatively left in the Disphyllidae for the present, equivalent to the classification adopted by Pedder (1964), Strusz (1965) and Jell (1969). *Zelolasma* may be distinguished from typical members of the Cyathophyllidae Dana in having a narrow dissepimentarium and more widely spaced, simpler tabulae.

The genus *Acinophyllum* McLaren, 1959 appears closely similar to *Zelolasma*, having a narrow dissepimentarium, short major septa and generally lacking tabellae. Pedder (1964) considered *Zelolasma* to differ in lacking the connecting processes between corallites of *Acinophyllum*, but these processes are not always developed clearly in the latter genus (McLaren, 1959) and do not appear to be of generic significance. Carinae are developed to a rather variable extent in *Acinophyllum* according to McLaren (1959) and Scrutton (1968), but Oliver (1974), after a thorough review of the genus, considered them to be generally strongly developed and this interpretation is followed here.

Some Silurian genera show similarities to *Zelolasma*. *Diplophyllum* Hall, 1852, reviewed by Oliver (1963), has a narrow dissepimentarium of globose dissepiments and broad tabularium of mainly complete tabulae similar to *Zelolasma*. It may be distinguished from the latter by having the septa strongly dilated at the tabularial margin to form an inner wall and it generally has longer major septa. The genus *Columnaria* Goldfuss, 1826 has both Devonian and Silurian representatives ; the Silurian forms most probably belonging to the genus have been reviewed by Norford (1962). They may be distinguished from *Zelolasma* by having the dissepiments in their single rank strongly elongate, as opposed to the globose forms of *Zelolasma*.

Zelolasma has not been previously recorded in strata older than Devonian, but several Silurian species may be representative of the genus. *Disphyllum praecox* Hill, 1940, discussed below, is here regarded as possibly belonging to *Zelolasma*. " *Diphyphyllum caespitosum* " (Hall, 1852) of Lambe (1901, Pl. XIII, fig. 3) is not congeneric with Hall's original material, the type of *Diplophyllum*, as mentioned by Oliver (1963). With a single row of globose dissepiments, mainly complete tabulae and short septa, Lambe's material could be representative of *Zelolasma*. " *Entelophyllum caespitosum* " (Hall) of Ivanovskiy (1963*a*, Pl. I, fig. 2 and 1963*b*, Pl. XXIV, fig. 1) seems to be conspecific with Lambe's " *Diphyphyllum caespitosum* " and hence may also belong to *Zelolasma*. These two forms would appear to be the oldest representatives of *Zelolasma* if confirmed, being of Middle to Upper Llandovery age.

Acervularia luxurians var. *breviseptata* Weissermel, 1894 described by Soshkina (1937, p. 63, Pl. XVII, figs 1, 2) from the ?Upper Silurian of the Urals may also be a representative of *Zelolasma*, being especially similar in dissepimental and tabular structure. It is not the same as Weissermel's form (Weissermel, 1894, p. 608, Pl. XLIX, figs 4, 5). Lavrusevich (1971*c*) considered Soshkina's material to be conspecific with *Z. gemmiforme*, but regarded it as being Lower Devonian rather than Upper Silurian in age.

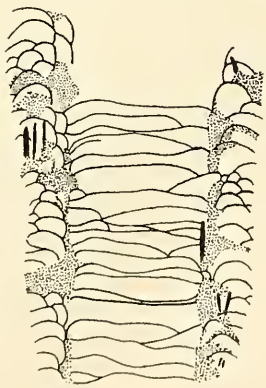
?*Diphyphyllum* sp. illustrated by Nikolaeva (1936, Pl. II, figs 6, 7) from the ?Middle or Upper Silurian of the River Kolyma area, north-east USSR, appears similar to *Zelolasma*, again particularly in dissepimental and tabularial characters, but there is some evidence of development of an inner wall and it may possibly be assigned more properly to *Diplophyllum*.

Range. Middle Llandovery of ?Anticosti Island ; Upper Llandovery of ?Siberian Platform, ?Anticosti Island ; Ludlow of ?N.S.W. ; ?Upper Silurian or early Devonian of ?the Urals ; Lower Devonian of Tadzhikistan and N.S.W.

Zelolasma? *praecox* (Hill, 1940)

Pl. XX, fig. 4 ; Pl. XXI, figs 5–7 ; Text-fig. 4

1940 *Disphyllum praecox* Hill, p. 398, Pl. XI, figs 15–17.



Text-fig. 4. *Zelolasma*? *praecox* (Hill) AM 603, longitudinal section, ×6.

Material. Holotype AM.F 9709 with thin-sections, AM 745, probably from the Barrandella Shale, Limestone Creek, near Bowning-Wargeilo road crossing, Yass region. Middle Ludlow. Paratypes—see Hill, 1940, p. 399. Additional specimen—AM.F 8505 with thin-sections AM 603, horizon uncertain, portion 35, Parish of Derringullen (Limestone Creek, near " Allview ").

Diagnosis. Corallum subphaceloid with connecting processes. Major septa withdrawn from axis, minor septa at least half length of major septa. Tabulae mainly complete, flat or weakly domed ; dissepiments in 1–3 rows, very strongly globose.

Description. See Hill, 1940, p. 398.

Remarks. "*Disphyllum*" *praecox* Hill, 1940 differs from *Disphyllum* in lacking the peripheral dilation of the septa characteristic of that genus, as well as lacking tabellae. These features ally it with *Zelolasma*, although it lacks the subequal major and minor septa and axial dilation of the septa in that genus. Hence it is only tentatively assigned here to *Zelolasma*. Both Hill (1940) and Pedder (1964) have noted the close similarity of "*D.*" *praecox* and *Z. gemmiforme*.

Z.? *praecox* differs from *Acinophyllum* McLaren in having only weakly developed carinae, but is otherwise closely similar to that genus. Wang (1947, p. 178) considered *Z*? *praecox* to be related to *Phacellophyllum* Gürich, but it lacks the grouped horseshoe dissepiments of that genus. Ivanovskiy (1965*b*, p. 98) listed the species as a representative of *Entelophyllum*, and while showing some similarities to this genus, more especially the doubtfully included forms with flattened tabulae and narrow dissepimentarium mentioned above, the typically short septa, very narrow dissepimentarium with generally horizontal dissepimental layers, and flat, complete, widely spaced tabulae clearly distinguish it from *Entelophyllum*.

Family GONIOPHYLLIDAE Dybowski, 1873

Genus RHIZOPHYLLUM Lindström, 1866

1974 *Rhizophyllum* McLean, p. 29 (*cum syn.*)

Type species. *Calceola gotlandica* Roemer, 1856 Eke, Hemse Beds (Ludlow), Gotland.

Diagnosis, Discussion and Range. See McLean (1974).

Rhizophyllum brachiatum sp. nov.

Pl. XXI, figs 1–4 ; Text-figs 5, 6

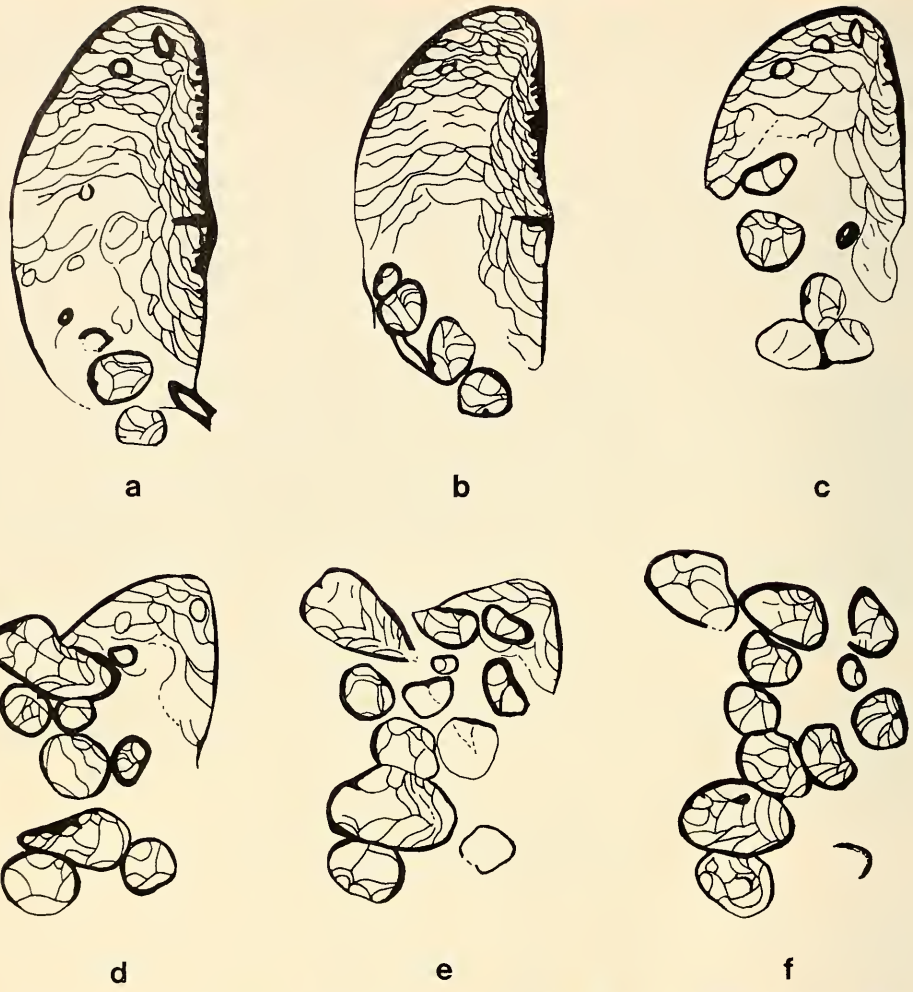
Derivation of name. Latin brachiatus=branching.

Material. Holotype MMF 12981. Fragmented colony. Barrandella Shale, "Silverdale", Yass region. Middle Ludlow.

Diagnosis. Corallum fasciculate with very long slender, subparallel corallites. Increase calicinal, parricidal. Septa irregularly developed, occurring on flat wall only. Zone of smaller dissepiments occurs adjacent to flat wall.

Description. Corallum fasciculate, colony (fragmented) attaining large size. Corallites very long, slender, frequently scolecoid, subparallel. Increase is calicinal, apparently parricidal with at least 12 offsets from the one calice (Text-fig. 5). Increase apparently occurs uncommonly after initial growth period of corallum, the many offsets from the one calice generally forming very long corallites that often extend throughout remainder of corallum. No apparent relationship is evident between orientation of counter septum of parent corallite and offsets, although some rotation of daughter corallites during growth is evident (Text-fig. 5). Hollow rootlets with transverse structures are abundantly developed for support between adjacent corallites, most commonly at angles but also on flat wall of corallites (Text-fig. 6). There is no clear development of an axial pit in calice.

Mature corallite diameter reaches $12 \times 7 \cdot 5$ mm with angles slightly rounded. Corallite height ranges to at least 10 cm. Counter septum clearly developed except in earliest growth stages (Pl. XXI, fig. 2 ; Text-fig. 5) where corallites have



Text-fig. 5a-f. *Rhizophyllum brachiatum* sp. nov. MMF 12981, transverse serial sections (5a is the most proximal section) illustrating progressive formation of calical offsets with elimination of the parent corallite. Approximately 1 cm of corallum growth is covered by the series of sections; traced from photographs of acetate peels. ×4.

Text-fig. 6. *Rhizophyllum brachiatum* sp. nov. MMF 12981, transverse section showing rootlets. Note transverse structures in broken rootlet. ×5.

not attained typical calceoloid shape. Counter septum is long and slender but other septa are irregularly and weakly developed, occurring only in mature corallites. They range in number to approximately 20–26, with major and minor septa not clearly distinguishable. Septa are confined to flat wall only.

Dissepiments in septal zone adjacent to flat wall are small, strongly elongate, in partial arched series approximately 0·3 of corallite diameter (Pl. XXI, fig. 3). Tabellae or dissepiments occupying remainder of corallite are larger, in moderately sagging series.

Vertical tube-like structures are commonly developed growing parallel to corallite wall and occurring just within curved rim of corallite (Pl. XXI, figs 1, 3, 4). These tubes have common diameter of 0·5–0·6 mm, with wall thickness of 0·08–0·1 mm. Sagging transverse plates, widely spaced, may be sporadically developed.

Remarks. Colonial representatives of *Rhizophyllum* include *R. elongatum* Lindström, 1883 from the Eke Beds (Middle Ludlow) of Gotland and the Kunzhak Horizon (? Lower Devonian) of central Tadzhikistan (Lavrusevich, 1971*b*) and *R. attenuatum* (Lyon, 1879) from the Louisville Limestone (late Wenlock—early Ludlow) of Indiana—Kentucky. In addition from the Wenlock or Ludlow of north-western California, Oliver (1964) recorded "*Rhizophyllum* sp. C." which, though poorly preserved, is probably a colonial form.

R. attenuatum has not been illustrated in thin section, but it can be distinguished from *R. elongatum* and *R. brachiatum* by having lateral rather than calical increase (Lindström, 1883, Pl. III, fig. 17). *R. brachiatum* may be differentiated from *R. elongatum* by the former having a clearly differentiated zone of smaller dissepiments adjacent to the flat wall and generally much longer corallites. *R. elongatum* however requires more illustration of thin sections.

It seems likely from the section illustrated in Text-fig. 6 that rootlets were formed as a type of lateral bud, with transverse structures internally. They apparently were then specialised as supporting structures. In structure the earliest stage of an offset does not appear distinguishable from a rootlet.

The tube-like structures occurring within the horizontal skeletal tissue of *R. brachiatum* are of problematical origin. Among the goniophyllids, similar structures are apparent in *R. elongatum* (Lindström, 1883, Pl. II, fig. 17 and Pl. IV, fig. 5) and the Devonian *Calceola sandalina* (Linnaeus, see Lafuste and Semenoff-Tian-Chansky, 1968). Plusquellec (1968*a*, *b*) has reviewed the occurrence of comparable structures in representatives of Palaeozoic corals and stromatoporoids, attributing them to commensal organisms of uncertain affinities. References to previous work on these structures may be obtained from Plusquellec's works.

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EXPLANATION OF PLATES

Plate xviii

Figs 1–7. *Palaeocyathus australis* Foerste. 1. SUP 74221b, transverse section, late neanic stage, ×6. 2. SUP 74236a, transverse section, neanic stage, ×6. 3. SUP 74224, longitudinal section, ×4. 4. SUP 69229, transverse section, ephebic stage, ×6. 5. SUP 74221a, transverse section, ephebic stage, ×6. 6. SUP 69228. transverse section, ephebic stage, ×6. 7. SUP 74239, longitudinal section, ×4.

Figs 8–10. *Entelophyllum yassense yassense* (Etheridge). 8. SUP 74254f, transverse section, early growth stages, ×3. 9. SUP 74253c, longitudinal section, ×3. 10. SUP 74254c, transverse section, ×2.

Plate xix

Fig. 1. *Entelophyllum yassense yassense* (Etheridge). SUP 74254d, transverse section, ×3.

Figs 2–6. *Entelophyllum yassense patulum* (Foerste). 2. SUP 69222, transverse section, ×1·5. 3. 69226a distal transverse section, ×1·5. 4. SUP 69226a, transverse section of axial region showing offsets. 5. SUP 69224, transverse section showing offset, lower right, ×1·5. 6. SUP 69226b, transverse section slightly more proximal than that in Fig. 3, showing distortion of septa near axis prior to formation of offsets.

Plate xx

Figs 1–3. *Entelophyllum yassense patulum* (Foerste). 1. SUP 69222b, longitudinal section, ×3. 2. SUP 69223 longitudinal section showing offset at right ×3. 3. SUP 69226c transverse section prior to formation of offsets, ×1·5.

Fig. 4. *Zelolasma*? *praecox* (Hill). AM 745, holotype, transverse section, ×4.

Plate xxi

Figs 1–4. *Rhizophyllum brachiatum* sp. nov. MMF 12981, ×6. 1. transverse section, ephebic stage. 2. transverse section, neanic stage (note long counter septum). 3. longitudinal section (flat wall at right). 4. transverse section, ephebic stage.

Figs 5–7. *Zelolasma*? *praecox* (Hill). 5. AM 603, transverse section, ×8. 6. AM 603, longitudinal section, ×6. 7. AM 3317 (AM.F 9879), paratype, longitudinal section, ×6.

Corrigendum

Proc. Linn. Soc. N.S.W., 99: 94. Pl. X, fig. 7, *read* SUP 39184b, transverse section, ×7.